AGRICULTURAL NEWS LETTER

VOL. 3 - NO. 3 MARCH 1935

THIS PUBLICATION GIVES INFORMATION on new developments of interest to agriculture based on the work done by scientists and agricultural field men of the du Pont Company and its subsidiary companies.

It also gives reports of results obtained with products developed by these companies in the field whether the tests are made by field men of the companies, by agricultural experiment stations or other bodies. Also data on certain work done by agricultural stations on their own account and other matters of interest in the agricultural field.

This issue contains:

Issued by
Publicity Bureau
E. I. du Pont de Nemours & Co.
Wilmington, Del.

MANGANESE -- A PLANT POISON WHICH PLANTS MUST HAVE TO LIVE AND GROW

EDITOR'S NOTE:- This discussion of uses of manganese in the growing of certain crops was prepared expressly for the AGRICULTURAL NEWS LETTER by specialists of the Office of Experiment Stations, James T. Jardine, Chief. Researches carried on in connection with manganese are typical of the highly important work of the agricultural experiment stations and the U. S. Department of Agriculture.

At the Rhode Island Experiment Station, in 1925, McLean and Gilbert treated spinach plants which had been grown on heavily limed, but not alkaline, soil with small quantities of various chemicals for the purpose of curing a condition called "chlorosis"--an unhealthy yellowish green color accompanied by poor growth. Of the compounds tried only manganese sulfate showed any curative effect. In only four days after the chlorotic plants had been sprayed with a very weak solution of manganese sulfate, however, the yellowish plants showed a definite improvement in color, and in a week the change had become very marked. Other spinach plants were then treated with a solution of eight parts of manganese sulfate in 1,000,000 of water --a trifle over an ounce in 2,000 gal. The plants so treated yielded 40 percent more than the untreated plants. This work of the Rhode Island Experiment Station seems to have been the first recognition of manganese as an essential plant food in a practical agricultural experiment. Later experiments of the same station have extended the use of manganese compounds to other crops--lettuce, onions, mangels, beets, corn, hay crops, etc.--and have produced, in many cases, startling increases in yield. For example, the application of but eight lb. to the acre in an experiment on spinach in 1925 increased the yield 215 percent!

There is usually a minute quantity of available manganese in soils; but when a soil is limed to something like a neutral reaction the soil manganese may be made almost completely insoluble. Since plant foods are available only when they can dissolve in the soil moisture, additions of very small quantities of manganese in a more soluble form may become necessary after the rather heavy liming required by some crops.

Similar results have been obtained at experiment stations as far from that of the original work as those in Oregon and Florida. The Ohio Experiment Station showed the effectiveness for greenhouse vegetables of broadcasting one lb. of manganese sulfate over a soil area of about 435 sq. ft. This treatment cured a chlorosis of tomatoes and cucumbers, restored the normal growth of these crops, and increased the yields by from 10 to 25 percent. Manganese, in very small quantities, was also necessary for the normal growth of

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bluegrass, and of certain yeasts and molds, at the Kentucky Experiment Station; and some North Carolina soils had to be treated with manganese to enable them to produce satisfactory crops of soybeans.

But if liming to, or near, neutrality can bring about the need for the addition of manganese, neglecting to correct soil acidity may result, perhaps equally readily, in making the natural manganese content of a soil soluble in doses which, while still very minute, are large enough to be poisonous to plants. This has been shown very definitely in greenhouse tobacco experiments carried out by the Connecticut Experiment Station; and manganese toxicity has required serious consideration in the cases of some crops grown on Hawaiian soils. Manganese deficiency has also appeared on Hawaiian soils, however. There are also, of course, many soils in which neither excess nor deficiency of manganese available to plants plays any part in the practical plant feeding problem. As near the original manganese experiments of the Rhode Island Experiment Station as the Massachusetts experimental plats, the Massachusetts Experiment Station showed that an addition of manganese was not necessary for optimum crop production; and some Texas soils have been found not to respond to treatment with manganese salts, though sorghum crops on certain Texas soils showed themselves distinctly in need of this element.

Obviously, manganese treatment is not a panacea for any and all cases of plant starvation which the usual ration of nitrogen, phosphorus, and potassium plant foods will not cure. The crop may be in need of minute traces of soluble compounds of boron, copper, zinc, and possibly of other elements not yet definitely known as required elements in plant nutrition. Moreover, a very small addition of soluble manganese in excess of what is actually needed may evidently require the further expense of rather heavy liming to make the toxic excess of manganese insoluble. The appearance of the characteristic sickly yellowish green in crop plants grown on soil which has been limed nearly to neutrality or on soil which is naturally nearly neutral would certainly seem to call for a careful and thorough trial of small applications of a soluble manganese compound; but even chlorosis and poor growth are not absolute indications of a deficiency in manganese alone. The Rhode Island Experiment Station has recently reported the discovery that in potatoes, at least, chlorosis and poor growth can result from an inadequate supply of magnesium; and the importance of magnesium in Maine has been taken so seriously by the Maine Experiment Station that it includes magnesium content guarantees and determinations in its last fertilizer report.

The instances specifically mentioned are examples only of the widespread study which has been given this important matter of manganese deficiency and manganese toxicity. One phase or another of the subject has already required the attention of almost every agricultural experiment station in the United States and that of U. S. Department Agriculture as well.

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The cheapest and best form in which to apply manganese seems generally to be that of the sulfate.

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HIGHER ALCOHOL SULFATES AS SPREADING AGENTS FOR INSECTICIDES AND FUNGICIDES ARE STUDIED

EDITOR'S NOTE:- It is believed that the information on higher alcohol sulfates, presented below, can be of value to those who are carrying on research and experiments in connection with the development of better vehicles for the wetting, spreading and sticking of insecticides and fungicides. Of particular interest, it would seem, is the relation of higher alcohol sulfates to the residue problem.

By W. H. Tisdale, Director, Pest Control Division,
Grasselli Chemical Company, Cleveland, Ohio.

The need for satisfactory wetting, spreading and sticking agents for use in the application of insecticides and fungicides has never been fully met. There are many products in use some of which have proven satisfactory for specific purposes. The need for spreading agents that will effectively withstand hard waters has long been recognized. The efficiency of sprays depends to a large extent on the thoroughness of application. Ordinary soaps, emulsified and sulfonated oils cannot be used successfully in some sprays and in some of natural hard waters. The establishing of tolerances on fruit and vegetables of poisons such as arsenic, lead and fluorine has resulted in systematic washing of fruit to remove these poisonous residues. Wetting agents that will tolerate the acid and alkali used in these washing baths are important.

Physical properties of insecticides and fungicides and the thoroughness with which they are applied determine their efficiency to a great extent. More attention is now being given to these problems than previously has been done. When applied as sprays satisfactory spreading agents should be used in the exact proportions required to produce thorough coverage without excess run-off. Too much spreader may be worse than none. Food sticking agents compatible with the active ingredients are often needed to hold the toxins in place, to prevent excess run-off, and removal by rains. In using sticking agents, however, it is desirable to keep in mind the ease of removal of spray residues by washing.

In the discovery of the higher alcohol sulfates it appears that a step forward has been made toward the solution of some of these problems. The du Pont Company has been interested in these products for use in the textile industry for a number of years. During the past three years the Organic Chemicals Department of the du Pont Company and the Grasselli Chemical Company have conducted extensive experiments and many field demonstrations of the use of these products in the agricultural field. These investigations have shown these compounds to have value for use in the preparation and application of insecticides and fungicides; for the preparation

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of emulsions and emulsifyable oils; and for the preparation of certain types of coating agents for fruit and nursery stock.

The sulfated alcohols have the following advantages:

(1) - They are excellent wetting and spreading agents for the preparation and application of insecticides and fungicides. For sprays some of them are effective in dilutions as great as .025 percent.

(2) - They are useful in the preparation of emulsions.

(3) - They can be used in acids and dilute aqueous alkali solutions.

(4) - They withstand hard waters.

(5) - When used as spreaders for certain contact insecticides they appear to activate these compounds.

(6) - When used in higher concentrations than needed for wetting and spreading purposes they have contact insecticidal value. However, injury to tender foliage may be caused to some plants with effective insecticidal concentrations.

Of the many combinations studied sodium lauryl sulfate (IN 181) and sodium oleyl sulfate special (IN 438) appear to be the best for wetting and spreading purposes. Sodium oleyl sulfate, special, is the more efficient of the above for wetting foliage and fruit and is more convenient to use, being a liquid which mixes readily with water. For combination with dry products sodium lauryl sulfate, which is a powder, is better. A combination of resinous materials has proven effective as a combined spreading and sticking agent for sprays. This product (SS-3) is a liquid which emulsifies readily when poured into water.

The Pest Control Section of the Grasselli Chemical Company which is interested in the further development of these products, for agricultural use, will be glad to cooperate with investigators interested in experiments by furnishing samples and further information.

CONTROLLING FUNGOUS SAP STAINS OF LUMBER BY USE OF MERCURIAL FUNGICIDE TREATMENTS

EDITOR'S NOTE:- The development of effective means of control of fungi in lumber was long a problem of considerable economic significance. Lumber sap-stains, caused by fungous parasites in the sapwood portion of boards, dimension stock and timbers, had cost the American lumber industry fully $100,000,000 during a ten-year period, it was estimated. The discovery of treatments to eliminate losses is, therefore, important.

BY C. E. GRAVES-PATHOLOGIST

PEST CONTROL SECTION--THE GRASSELLI CHEMICAL COMPANY

Bright lumber, free from any evidence of fungous infection, is desired wherever wood is used in construction. However, until a few years ago, most air-dried lumber carried a high percentage of the fungous sap-stain discoloration commonly known as "blue-stain." Of course, badly stained lumber often is discriminated against because of its ugly, dark, blotched appearance. It cannot be used for finish work where the natural color of the wood is desired. Also, despite the fact that tests do not prove it so, many builders regard sap-stain with suspicion, believing it to be an early stage of decay.

It is well known that stain-producing fungi attack green, moist sapwood during the early part of the air-seasoning period. Therefore, the development of a fungicide for treating the lumber as it comes from the sawmill has long appeared to be the most logical means of control. The soda treatment was the first step in this direction and is fairly successful, provided proper care is used in application. To be most efficient, the soda solution must be of at least 5% concentration. Also, it is necessary to heat it to 150°F to 175°F. Soda solution imparts a yellowish color to the wood which is sometimes considered objectionable. The hot alkali is often injurious to the hands of workmen. Also, its use is restricted principally to pine as most hardwoods do not respond to the soda treatment.

The need for an improved anti-stain chemical became so great that forest pathologists of the U. S. Department of Agriculture, some of the more progressive lumber manufacturers and a number of interested chemical concerns developed programs of research in this field. While it seemed as though it should be a fairly easy matter to find a suitable fungicide for the purpose, between 1928 and 1934 the U. S. D. A. forest products pathologists tested more than 100 compounds at various sawmill operations in the South.

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An Effective Control

The du Pont Company developed and submitted several ethyl mercury compounds for testing, some of which are now well known because of their value as seed disinfectants. Ethyl mercury chloride and ethyl mercury phosphate were found to be especially effective against stain fungi. In numerous tests, where undipped lumber showed 60% or more of the sapwood area stained, these ethyl mercury compounds usually reduced infection to a fraction of a percent.

After two years of experimental work, during which time the results obtained by the pathologists of the U. S. D. A. and of the du Pont Company were in agreement, ethyl mercury chloride was offered to lumber manufacturers for sap-stain control. That it has been well received and quite successful, is shown by the fact that during 1934 sufficient of the ethyl mercury chloride fungicide for lumber was distributed to treat approximately a billion and a half board feet of lumber and squared timbers. Used in cold solution, this sap-stain preventive can be applied at even the smallest sawmill, where a hot solution would be out of the question. The concentration recommended has not proved to be injurious to the hands of workmen handling the dipped lumber.

In the South, where hardwoods are becoming of increasing importance as the pine stands of timber are cut out, the ethyl mercury chloride compound has found wide usage. It is equally effective against the organisms attacking both hardwoods and pine. Operators cutting both pine and hardwoods find it especially convenient, as they can dip all their lumber in one vat. In Canada, Mexico, Sweden, Finland, Australia and the Philippine Islands experiments and commercial use have proven ethyl mercury chloride effective against stain-fungi attacking numerous species of lumber cut in those countries.

One characteristic of this compound is its volatility. No trace of mercury has been found in shavings taken from lumber remaining on sticks for six weeks or more. However, the critical period for stain development is generally during the first three or four weeks of seasoning, after which time the lumber should be too dry to stain, if good piling practices are followed.

A New Development

A new compound, designated as LE-5 and containing oil soluble ethyl mercury oleate, has proved itself effective against sap-stain fungi. Used in an emulsifiable oil, it can be mixed with water and applied to lumber in the same manner as the older treatment. Of course, the active ingredient remains in the oil phase and the water merely acts as a vehicle for spreading the fungicide over the surface of the wood. It is believed this compound may have several advantages. It is not easily removed by

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rain falling on dipped lumber. It is somewhat less volatile than ethyl mercury chloride, which is probably the reason why several tests have shown it to be a little more effective under slow drying conditions. Ethyl mercury oleate does not weaken in the vat with use and some manufacturers feel the oily liquid is easier to handle than a dry, powdered compound.

Ethyl mercury oleate, in an oil emulsion spray, has been found valuable for controlling certain fungous diseases of citrus in Florida. It is being used as a preservative for cordage and for inhibiting the growth of certain marine weed forms on fish nets. It is also being tested for numerous other purposes where an extremely powerful fungicide is needed. It is adaptable for use in an oil solvent or it can be emulsified in oil and diluted with water for application.

THE PERFORMANCE OF CERTAIN INORGANIC INSECTICIDE DUSTS IN THE CONTROL OF CUCUMBER BEETLES

EDITOR'S NOTE:- The Pest Control Section, Grasselli Chemical Co., carried on chemical and biological research and provided technical sales service in the development and uses of insecticides, fungicides, weed killers, rodent poisons, and other protective agents for agricultural and commercial purposes. Dr. Harry F. Dietz and E. E. Zeisert are members of its staff.

By Harry F. Dietz(1) and E. E. Zeisert(2)

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The purpose of this investigation was to test the reliability of the results obtained through several indirect methods of evaluating the insecticidal performance of treatments used in the control of free moving truck crop insects.

The indirect methods chosen are those generally employed in evaluating the insecticidal efficiency of dust and liquid insecticides used in the control of the cucumber beetles (*Diabrotica vittata* Fabr. and *D. duodecempunctata* Oliv.). Therefore, cucumbers were chosen as the test plant and these beetles as the test insect. To simplify the problem the test treatments were restricted to inorganic insecticide dusts.

In order to avoid misunderstanding, the term indirect methods of evaluating performance applies to such measurements as are not directly referable to counts of reduction in insect population or to the actual percentage of insects killed. Instead, reactions of the host plant, measured in length of vine growth; yield in weight of fruit; yield in total number of fruits produced; and freedom from bacterial wilt are used as criteria of insecticidal performance. Such use of these criteria is based on the assumption, tacit or otherwise, that reduction in population or percentage of kill is directly reflected in the plant reactions enumerated above. Of course treatments resulting in immediate, serious injury are excluded.

If these several indirect ways of evaluating insecticidal efficiency are all closely correlated with reduction in insect population, it is natural to expect agreement in the results obtained from each. Our data do not support this premise.

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Experimental Technique

Although it is axiomatic that the results obtained are inherent in the methods and in the measurements used, technique becomes an important factor when the real value is and remains an unknown.

It is an incontroversible fact that the number of uncontrolled and uncontrollable variables occurring in field experiments is large. The only possible escape from such dilemma is to control as many variables as possible and to measure or eliminate, insofar as possible, the effects of the rest. The best way to measure such uncontrollable variations as soil heterogeneity, differences in population in different parts of a planting, and similar factors is through restricted randomized replications.

Replications: Three hills of four cucumber plants each were used for each replication of a treatment and each treatment was replicated five times. Thus a total of sixty plants were used for each treatment. The distribution of the replications was made so that no treatment occurred more than once in the same row in either direction across the planting.

The planting was made on a level, fertile plot of soil with the hills spaced 10 x 12 feet. This wide spacing was employed because previous experience over three years had shown the necessity of wide spacing in order to avoid:
(a) the interlacing of vines; (b) the drifting of the dust treatments to adjacent hills; (c) undue injury to the plants through cultivation; and (d) the packing of soil while taking measurements, applying treatments and picking the fruits. At mid-picking season it was apparent that such spacing was not excessive.

Treatments Used: (1) Calcium arsenate - gypsum mixed in two ratios, 1 to 4 and 1 to 9 by weight. These were used as reference or standard treatments.
(2) Barium fluosilicate (Dutox) diluted in the ratio of 1 to 4 by weight with talc, flour, clay, high calcium and high magnesium lime, and a mixture of equal parts of talc and flour.

(3) Manganese arsenate compound (Manganar) mixed with gypsum and high magnesium lime in the ratio of 1 to 4; and with basic copper chloride and talc in a 1-1-3 ratio.

The gypsum, lime, and clay diluents were of 300 mesh size and very satisfactory for dusting purposes.

Time and Method of Applications: All materials were applied as dusts and always on the same day. The first application was made soon after the plants appeared above the ground and their cotyledons expanded. A total of nine applications were made beginning June 21 (the first) and ending July 23 (the last). The time interval

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between applications was determined by the following factors; first, rainfall following previous application washing the dust from the plants; second, the observed abundance of insects in the planting; and third, the rapidity of growth. All plants were kept lightly and thoroughly covered with dust until fruiting began.

All applications were made with a Root Hand Duster, an exact record was kept of the amount (by weight) of dust used for each treatment.

The procedure in dusting was as follows: The first operation was to direct one or two strong puffs of dust into the center of each hill. This was done to secure thorough coverage of the bases of the plants, where the adult insects prefer to feed, particularly when the plants are young. The soil around the plants was likewise lightly and thoroughly covered. Subsequent puffs were directed to the undersides of the foliage and the final puffs to the upper surfaces. The number of puffs were kept as nearly equal as possible, taking intc consideration differences in the size of the plants and the securing of a uniform visible coverage.

Since the weight of the material applied is known, we have some information relative to the influence on coverage of such physical properties of the diluent as density, suspensibility in air, cohesiveness and ease of flow. Color also is a factor as it influences the visibility of the dust on the plant.

Population Counts: These counts were made just before and within twenty-four hours after any given dust application.

The small size and the agility of these insects which enables them to conceal themselves in the heavy foliage of well-grown cucumber plants obviously makes such counts by themselves inadequate. This is the primary reason why indirect methods of evaluation must be resorted to. Inaccurate as such counts admittedly are, they were taken for purposes of comparison with the indirect methods.

Vine or Growth Measurements: Two such measurements were taken, the first following the sixth dust application; the second, just before picking time and after all treatment had been discontinued.

Picking and Size of Fruit Picked: Picking began on July 31 and was continued at three day intervals until September 15. All fruits two inches or over were removed at every picking and the number and weight of fruits recorded.

Results Obtained from Indirect Methods

Table I shows the effects of these dust treatments on vine growth, number and weight of fruit, and incidence of bacterial wilt.

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The following conclusions may be drawn from these data:

(1) In no case do the highest average vine growth, the largest number of fruits, the greatest weight of fruit and the lowest incidence of bacterial wilt all occur in the same treatment.

(2) The incidence of wilt in any given treatment is obviously the most consistent measure of insecticidal efficiency and the average vine growth the least.

(3) Since cucumber beetles are the vectors of bacterial wilt, the incidence of this disease should and does coincide most closely with the observed abundance of insects found in the different treatments in the nine examinations made prior to each dusting. On four different inspections, of the nine made, no beetles were found in Treatments c, d, e, h and k. The only dead insects found around the plants were in Treatments c, d, and e.

(4) If the percentage wilt is taken as the best indirect measure of insecticidal efficiency, then it is clearly shown that the use of such chemically active diluents as high magnesium and high calcium lime cause a marked reduction in the efficiency of barium fluosilicate.

(5) High magnesium lime appears to cause less reduction in efficiency than high calcium lime.

(6) The technique of dusting used was satisfactory from the standpoint of uniformity of application as is shown by the following facts. Where the same diluent was used with different toxicants as gypsum with calcium arsenate and with manganese arsenate the total quantity used in nine applications varied only three ounces. The same statement applies to the use of high magnesium lime with manganese arsenate and barium fluosilicate.

(7) Where different diluents are used with the same toxicant the physical properties of the diluent such as density, suspensibility in air, cohesiveness and ease of flow influence the quantity of material applied by the same method of application. Visibility of the dust on the plant also is a factor.

Summary

(1) The growth and yield of plants are not necessarily a measure of insecticidal efficiency and may be influenced by factors quite distinct from freedom of insect attack.

(2) The results measured as weight of fruit and total number of fruit do not necessarily coincide and neither value by itself may be taken as a measure of insecticidal efficiency, unless supported by other evidence of a more direct nature.

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(3) When indirect methods of evaluating insecticidal performance are used the variations between them are sufficiently great, so that no one measure can be used alone and several must be considered collectively.

(4) Direct measurements, no matter how inadequate they may seem should be taken and the results compared with those obtained by indirect methods.

(5) When the results of several methods are considered collectively a number of treatments may group themselves as among the best, any one of which would give satisfactory commercial control.

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TABLE I

Showing the Ranking of Various Inorganic Insecticide Dusts as Measured by Indirect Methods of Evaluating Performance

Treatment		Total Wt. of Dust Ounces	Weight of Fruit Pounds	Rank by Weight	Number of Fruits	Rank by No. of Fruits	Av. Length of Vines Inches	Rank by Av. Vine Length	Percent of wilt Present	Rank by wilt Control	No. Inspections free from Beetles	Dead Beetles Found
A. Ca arsenate Gypsum	1 4	78	309	1	3231	1	33.9	6	6.6	3	0	--
H. Ba fluosilicate * Talc Flour	1 2 2	64	291	2	2905	2	28.75	9	1.6	2	4	--
K. Mn arsenate** Copper Oxychloride Talc	1 1 3	64	289	3	2685	4	37.8	2	0.0	1	4	--
I. Mn arsenate Gypsum	1 4	76	266	4	2430	8	38.9	1	12.8	5	3	--
E. Ba fluosilicate Talc	1 4	55	260	5	2437	7	36.0	5	1.6	2	4	Yes
C. Ba fluosilicate Flour	1 4	84	252	6	2797	3	30.2	8	1.6	2	4	Yes
B. Ca arsenate Gypsum	1 9	75	247	7	2544	6	33.9	6	9.6	4	0	--
D. Ba fluosilicate Dawson Clay	1 4	61	245	8	2568	5	28.5	10	1.6	2	4	Yes
G. Ba fluosilicate High Mg. lime	1 4	67	209	9	1977	10	33.5	7	23.3	7	2	--
J. Mn arsenate High Mg. lime	1 4	66	203	10	1998	9	36.6	4	18.3	6	0	--
F. Ba fluosilicate High Ca lime	1 4	72	175	11	1609	11	37.5	3	33.3	8	0	--
Untreated Check		--	136	12	1125	12	***	--	50.0	9	0	--

* Ba fluosilicate refers to Dutox

** Mn arsenate refers to the compound, Manganar.

*** Too many plants being measured were lost from wilt, so no valid average was obtained.

TREATING SEED GRAIN FOR CONTROL OF DISEASES IS URGED BY U. S. DEPARTMENT OF AGRICULTURE

EDITOR'S NOTE:- Supplementing published warnings to growers to treat seed grain to control certain seed-borne diseases, the U. S. Department of Agriculture has issued Miscellaneous Publication No. 219, titled "Treat Seed Grain." The data below are from this leaflet.

By A. G. Johnson, principal pathologist, Division of Cereal Crops and Diseases, R. J. Haskell, senior extension plant pathologist, Extension Service and Bureau of Plant Industry, and R. W. Leukel, associate pathologist, Division of Cereal Crops and Diseases, Bureau of Plant Industry.

Treating seed grain for the control of certain smuts and other diseases is a standard recommended practice. It improved yield and quality. It provides good insurance against losses from certain diseases, and unless the grower is sure that his seed is not contaminated, treatment should be given to all seed wheat, oats, barley, and grain sorghum.

After seed grain has been thoroughly cleaned, treat it according to the following directions for controlling the seed-borne diseases listed below:

Crops and diseases	Seed Treatment (Numbers refer to descriptions following)
Spring wheat (hard red, white, and durum):	
Stinking smut (bunt)	No. 1, 2, or 5.
Winter wheat:	
Stinking smut (bunt)	No. 1 or 2
Oats:	
Loose and covered smuts	No. 2, 3, 4, 5, or 6
Barley:	
Covered smut and black loose smut	No. 2, 3, 5, or 6.
Stripe	No. 2
Grain Sorghum:	
Covered kernel smut	No. 1.

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No. 1. Copper Carbonate Dust Treatment

(Applicable to spring, winter, and durum wheats for stinking smut control, and to sorghums for the control of covered kernel smut. Not applicable to oats and barley)

Use a full-strength copper carbonate dust (about 50 percent copper), manufactured especially for seed treatment. Apply at the rate of 2 to 2½ ounces per bushel of well-cleaned seed. Mix the seed and the dust in a tight mixing machine until every kernel is thoroughly covered with the dust. Seed thus treated may be stored indefinitely until sown, without injury to germination. With this chemical, care must be used to avoid damage to the grain drill. Sometimes there is a tendency for the treated seed to cake in the drill, when standing overnight, or longer, in damp or wet weather. In such cases it is advisable to rock the drill wheels back and forth before starting in order to avoid breaking or bending the working parts. All working parts of the drill should be kept well oiled. The treated grain should be well cleaned out of the drill when seeding is completed to avoid corrosion of the parts. Seed treated with copper carbonate should not be fed to farm animals.

No. 2. Ethyl Mercury Phosphate Dust Treatment (Improved Ceresan)

(Applicable to spring, winter, and durum wheats, oats, and barley for the control of all diseases listed on p.1)

Use ethyl mercury phosphate dust manufactured especially for seed treatment. Apply at the rate of one half ounce per bushel in a mixing machine, or as recommended in directions on the container. The dusted grain should be kept in a bin, pile, wagon box, or sacks for at least ten hours. During this period dusted grain should remain uncovered. Treated grain may then be seeded at once or stored for at least four weeks. Ordinarily, grain should not be treated more than four weeks before seeding time because of uncertainty as to the effect on seed germination after this period. This treatment has the advantage of being applicable to wheat, oats, and barley, is easily applied, does not cake in the drill, and is non-corrosive to drill parts. As in the case of copper carbonate, seed treated with this chemical should not be fed to farm animals. Do not apply more than one-half ounce of this disinfectant per bushel. An excess may injure germination.

No. 3. Formaldehyde Dust Treatment

(Applicable to oats for the control of oats smuts and to barley for the control of covered smut and black loose smut. Does not control barley stripe)

There are several brands of formaldehyde dust on the market. They contain from four to eight percent of commercial formaldehyde by

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weight. These are usually applied at the rate of about three ounces per bushel (see directions on container). Use a tight mixing machine or apply by the shovel method. Pile and cover with canvas, blankets or sacks for at least one day. Then sow as soon as possible. This is a convenient treatment for oats and barley smuts, but as noted above, it does not control barley stripe. Not recommended for wheat because it does not control stinking smut and may injure germination.

No. 4. Formaldehyde Spray Treatment (Dry)

(Applicable only to oats for smut control)

Mix one pint of commercial formaldehyde with one pint of water. Apply this mixture uniformly with a sprayer at the rate of one quart of the mixture to 50 bushels of seed as it leaves the grain spout or as it is being shoveled from one pile to another on a clean floor or canvas, or in a tight wagon box. Bin it or pile and cover with canvas, blankets, or disinfected sacks for at least five hours, or overnight. Then sow immediately or expose to air before storing for any length of time. If treated grain is stored in an elevator it should be moved and aerated on the following day. This is a convenient method for treating large quantities of seed oats rapidly.

No. 5. Formaldehyde Dip Treatment (Wet)

(Applicable to spring wheat, durum wheat, oats and barley. Does not control barley stripe)

Mix one pint of commercial formaldehyde with 40 gallons of water in a barrel or tank. For best results the temperature of the water should be about 60 degrees to 70 degrees F. Dip loosely filled burlap sacks in this solution until the grain is thoroughly wet. Drain and dry two hours, or overnight. Then sow immediately. If the sowing must be delayed, spread out the treated seed to dry and sow as soon as possible. Formaldehyde-treated oats may be held longer than treated wheat without injuring germination. The treatment sometimes injures germination to some extent, particularly in the case of wheat when held for some time after treatment or when sown in dry soil. Treated seed should not be allowed to freeze while it is damp or wet. If grain is moist, increase seeding rate about one-fourth.

No. 6. Formaldehyde Sprinkle Treatment (Wet)

(Applicable to oats and barley. Does not control barley stripe)

Mix one pint of commercial formaldehyde with forty gallons of water at a temperature of 60 degrees to 70 degrees F., and, with a sprinkling can, sprinkle it uniformly on 50 bushels of seed grain as it is

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being shoveled from one pile to another on a clean floor or canvas, or in a tight wagon box. Shovel until all the seed is thoroughly wet. Pile and cover with canvas, blankets, or disinfected sacks for at least two hours, or overnight. Then sow immediately. If the sowing must be delayed, spread out the treated seed to dry and sow as soon as possible. This treatment has the same limitations as No. 5. Treated seed should not be allowed to freeze while it is damp or wet. If grain is moist, increase seeding rate about one-fourth.

Caution - Copper carbonate and ethyl mercury phosphate (Improved Ceresan) dust are poisonous, and formaldehyde fumes are irritating. Therefore, avoid inhaling these compounds as much as possible. Treat seed in a well-ventilated place or outdoors. Wear a dry cloth or a dust mask over the nose and mouth.

For further information consult your county agent or write your State Extension Service or the United States Department of Agriculture.

METHODS OF REDUCING THE RETAIL PRICES OF FERTILIZERS INDICATED BY INVESTIGATIONS

EDITOR'S NOTE:- Space limitations preclude the use in its entirety of the paper from which the abstracts below are taken. Therefore, it is suggested that those interested obtain complete copies. Reprints are available and will be sent on request from the office of the AGRICULTURAL NEWS LETTER, Room 9120, Du Pont Building, Wilmington, Del.

These abstracts are from "Plant Food Concentration as a Factor in the Retail Prices of Fertilizers," a paper by Dr. William H. Ross and Arnon L. Mehring, Fertilizer Investigations, Bureau of Chemistry and Soils, U. S. Department of Agriculture. It appeared in Industrial and Engineering Chemistry, News Section, December 10, 1934.

"A reduction in the cost of fertilizers in addition to that resulting from increased concentration may be secured by decreasing the wholesale prices of fertilizer materials; by substituting inorganic nitrogen for the more expensive organic nitrogen; by reducing freight rates for fertilizers; and by applying all fertilizers at the time of planting.

"Much progress has been made during the past few years in developing new and cheaper methods of fertilizer manufacture. As a result of these improvements, the mean wholesale price of all fertilizer materials, excluding the organic ammoniates, is now only about one-half of what it was in 1900 in spite of the fact that labor costs have increased. Research in fertilizer technology is still in progress, and it is only reasonable to assume that this will result in further reductions in manufacturing costs. It will not be possible, however, for further reductions in manufacturing costs to proceed indefinitely in the future at the same rate as in the past.

"For many years the wholesale prices of ammonia, nitrate, and organic nitrogen were approximately the same. At present, however, there is a wide variation in the cost of these different forms of nitrogen and the proportion in which they are used in mixed fertilizers has an important bearing on the cost of the fertilizers. Results so far obtained in field tests (3,4) made in different parts of the country indicate that all three forms of nitrogen produce similar crop yields, provided the acid-forming nitrogen carriers are supplemented with sufficient limestone or dolomite to maintain the reaction of the soil the same for all fertilizers. In sections where this proves true, there will be more economy in the use of the cheaper inorganic nitrogen than of organic nitrogen.

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"It has long been known that ammonia nitrogen undergoes less rapid leaching from the soil than nitrate nitrogen. It has therefore, been suggested that the use at planting time of a sufficient quantity of ammonia nitrogen in physiologically neutral mixtures might eliminate the necessity of applying nitrate nitrogen as a side dressing. Many farmers apply half of their nitrogen at planting time and the other half later as a side dressing. If all this nitrogen were to be applied in fertilizer mixtures at the time of planting there would therefore be a marked saving in the fact, as illustrated in Table 3, that the plant food concentration of the mixed fertilizer is increased. This saving would be in addition to that of the labor involved in making separate fertilizer applications.

"In Table 5 the possible savings to the farmer by the elimination of filler and by the use of double strength goods are compared with the savings that would accrue from each of the other changes in fertilizer practice already mentioned. In calculating these savings, it is assumed that the wholesale prices of inorganic nitrogen, phosphoric acid, and potash are cut in half; that the freight rates of fertilizers are cut in half; that the organic nitrogen in fertilizers is either replaced by, or reduced in price to that of inorganic nitrogen; and that side dressing is eliminated by applying all fertilizer at time of planting. The calculations were based upon the price of a 4-8-4 fertilizer containing 25 percent of its nitrogen in the organic form. The wholesale prices used were the averages for the principal fertilizer materials as quoted by the Oil, Paint, and Drug Reporter."

"The data given in Table 5 shows that the savings resulting from the substitution of inorganic nitrogen for organic nitrogen, or the application of all fertilizers at the time of planting will result in approximately the same savings to the farmer as though the wholesale prices of the carriers of inorganic nitrogen, phosphoric acid, or potash were cut in half; that a still greater saving would accrue to the farmer if filler were eliminated from fertilizer mixture; and that the farmer who uses double-strength fertilizers makes from two to three times as great a saving in his fertilizer bill as would be possible from the consummation of any of the other methods for effecting a saving in the retail cost of fertilizers."

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Table 5. Possible savings to the farmer in the cost of Plant food by changes as indicated based on the price of a 4-8-4 mixture containing 25 percent of its nitrogen as an organic ammoniate.

Change	Northern Maine %	North Carolina %	Georgia %	Indiana %
Halving wholesale price of inorganic nitrogen	5.2	6.2	6.2**	5.8
Halving wholesale price of P_2O_5	5.6	6.7	6.6	6.2
Halving wholesale price of potash	4.1	4.9	4.8	4.5
Halving freight rates on mixed goods	7.7	4.2	4.2	6.0
Replacing nitrogen from organics by inorganic nitrogen	5.7	6.8	6.7**	9.8
Eliminating side dressing by applying all fertilizer at planting*	9.5	6.5	7.0	6.1
Eliminating inert filler*	10.4	8.2	8.9	7.3
Using double strength goods*	26.2	20.6	22.3	14.2

* Does not include savings in labor.
** Per unit of ammonia

Note: The table as given here is incomplete.

Literature Cited.

(3) - Paden, Am. Fertilizer, 80, No. 10, 5 (1934)
(4) - Tidmore and Williamson, Am. Fertilizer, 79 No. 11, 6 (1933)

FARMERS ADVISED TO MAKE DAMS OR PONDS TO CONSERVE WATER IN EVENT OF DROUGHT

EDITOR'S NOTE:- This is the second of a series of articles describing methods followed in the blasting of reservoirs to store water for farm uses. In an early issue, Mr. Livingston will discuss the post-hole method of deep blasting, and will later give directions for cleaning out ponds and water holes.

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Until such time -- if it ever will come -- that periods of drought can be forecasted, the farmer should be prepared to combat water shortage whether the need arise or not. Obviously, the thing to do is to conserve water by storing it when it is available against days when it may be sorely required. This may be done by means of dams, where there is a stream, or by making ponds, or water holes or "tanks", as they are styled in some sections.

Blasting Shallow Ponds

A pond up to 40 feet in width and of any desired length, and varying in depths from 2½ to 4½ feet can be made by blasting, using the cross-section method of loading.

In general, this method consists of putting down a center line of "connector" holes extending for the length of the pond, and parallel rows, 36 inches apart, across the width of the pond for its entire length.

Holes are spaced 18 inches or 24 inches apart in a row; the latter for 3-stick loads under very favorable conditions. The holes vary in depth according to the depth of pond desired and the quantity of dynamite required to give that depth.

Ditching dynamite is the explosive used, and the loads range from a single stick to three sticks per hole. It is important that the upper end of a single stick or that of the top stick of two or three sticks be not more than four to 12 inches below the surface. Unless there is enough water on the surface or in the ground to fill up the loaded holes, it is always necessary to use mud or some other tamping material.

Another essential requirement of cross-section shooting is that the earth be sufficiently wet, since the blasting must be done by

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the propagated method. This method depends upon water in the ground to act as the vehicle whereby the "explosion wave", set up by the explosion of the initial hole, is transmitted to all others. As is generally known, in shooting by propagation, it is necessary to prime only a single cartridge of dynamite in but one hole of an entire series. The primer may be an electric blasting cap -- requiring a blasting machine to fire the cap -- or the primer may be a blasting cap and fuse.

A Pond Blasting Plan

For blasting a pond 40 feet wide and 3½ feet deep, make a single row of holes along the center of the area to be blasted and for its length. Space the holes in this row 18 inches apart. At every other, or second hole, make a cross row of holes, with nine holes at 18-inch intervals, on either side of the center line. This will give parallel rows of holes, extending the width of the pond area and spaced 36 inches between rows. All holes should be two feet deep.

Loading and Safety

Load all the holes in the area to be blasted, using two sticks of dynamite for each hole. Prime a stick with a blasting cap and use it as the top stick in one hole on the center line. If a cap and fuse are used for priming, care should be taken to see that the fuse is sufficiently long. Preferably, the primed hole should be the end one or near the end of those of the center line row.

Where an electric blasting cap is used, any hole of those on the center line may be primed, as the wires from the blasting machine can be long enough to permit the blaster to take a safe distance. The primed stick must be the last one loaded, to avoid possibility of a premature explosion while the other holes are being loaded.

The detonation of the primed hole will start the process of propagation, with the result that the entire area will be blasted at one time, in what will appear to be the simultaneous explosion of the dynamite in all the holes.

Users of dynamite should understand safety rules, and observe them strictly.

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